parasol ants, and repays their hospitality by feeding upon them. The natives firmly believe that the "serpent a deux tetes," as they call it, is the mother of the ants, and that they procure the leaves for the purpose of feeding it.

The larvæ were imbedded in a soft woolly matter which proved to be the finely masticated parenchyma of the leaves. Thus a use was found for the leaves, although it reflects seriously upon the supposed sagacity of the ants that they should procure so many more than are required for the purpose. Bates states that the leaves are also used for thatching the domes over the entrances to the mines, but I have not observed this practice in connection with the Trinidad species. The larvæ are fed by juices secreted by the nurses. A part of the larvæ emerge from the eggs winged and ready for their nuptial flight. These are the males and females, and the swarming occurs during the wet season. The female measures an inch in length and two inches in expanse of wing. The wings are clear, transparent and coarsely veined. The winged males and females emerge from the woods in clouds during the rains of April and May. These are almost all destroyed by the flycatchers, jackamars, ant-thrushes, &c., which greedily devour them; only a few impregnated females survive the slaughter to found new colonies and propagate their race. The colony is sustained, I suppose, as in other species, by the seizure and detention of impregnated females by their own subjects. After impregnation the female loses her wings, these being broken off by the insect itself. There may be noticed a natural suture at the base of the wing, doubtless that this may be easily broken off when no longer required.

——:o:——

THE TEREDO, OR SHIPWORM.

BY R. E. C. STEARNS.

THERE are several species of what are popularly called "shipworms" which are ordinarily included under the name Teredo. Although to the common observer they have a worm-like appearance, they are not worms, but true shell-bearing mollusks, as much so as the common "long clam," "long-necked clam" or "mananose" (*Mya arenaria*) of the Atlantic coast of the United States.

So much has been written in relation to the shipworms that it

would be nearly impossible to write anything that would not be a repetition or quotation. The shipworms (Teredo) were known to the ancients, and Theophrastus, the friend and successor of Aristotle in the lyceum at Athens, observed their operations 350 B. C.

The late Dr. J. Gwyn Jeffreys,[1] in his excellent volumes on the mollusks of Great Britain, presents in a very concise and interesting way what is in fact a most valuable memoir on the shipworm, Teredinidæ.

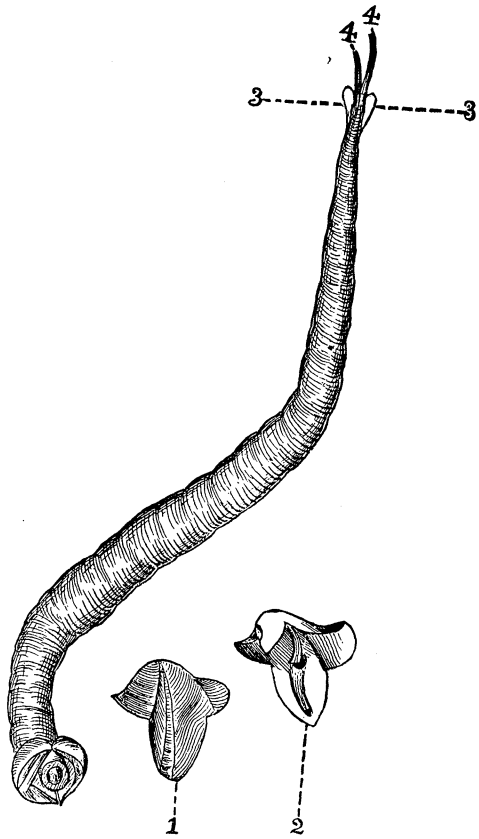
The shipworms are *bivalves*, that is to say, the complete shell is in two pieces, although one can form no idea of the Teredo from them, as the shelly part is but an insignificant portion of the entire animal, as you will learn from the following:

"The Teredo * * * consists of a long and nearly gelatinous, worm-like body, without rings or segments, terminating at one end in a pair of * * * valves that somewhat resemble the two halves of a split nutshell which has had a large slice cut off at each side, and at the other in a pair of symmetrical shelly paddles with handles of different lengths, which close this extremity at the will of the animal. The open part of the bivalve shell is placed at the further end, and receives a circular disk of a fleshy or rather muscular nature, which may be termed the foot; this is the broadest and widest part. Inside each valve is seen a curved process, like a bill-hook, that projects from the hinge at a right angle. The shell covers and protects the mouth, palps, liver and other delicate organs. The body tapers gradually to the outer or nearer end, where it becomes quite small and attenuated; it contains the gullet, intestine and gills, which form at the outward point two cylindrical tubes, mostly of unequal length. The larger tube takes in infusoria or similar animalcules, which constitute the food of the Teredo, as well as imbibes water charged with air for the purpose of respiration and keeping the whole fabric moist, while the smaller tube is employed in the ejection of the water which has been exhausted or deprived of aeriferous qualities, and also serves to get rid of the woody pulp that is excavated by the Teredo. Both tubes form a kind of hydraulic machine. At the base of each lies one of the paddles often termed 'pallets.' * * *

"When the Teredo is alarmed, or not feeding, it withdraws its tubes into the neck of its sheath or shelly cylinder; and the pallets which had been previously kept pressed against the sides, then spring forward and close the opening so as to form an efficacious barrier against all foes," etc.

[1] British Conchology, Vol. III, pp. 122–184. See also the Dictionaire Universal d'Histoire, Vol. XII, p. 358, under the title "Taret," and the Encyclopedia Britannica, Vol. XV, p. 353, under "Mollusca."

"The whole of what I have endeavored to describe is found only within some hard vegetable substance, either the hull of a vessel or boat, a harbor pile, a shipping stage, a floating tree * * * a beacon or buoy," raft timbers, old spars and masts, the planking or bracing of wharves, bridges, &c., &c., and old hulks or wrecks. The Teredo bores into these the same as a



1, outside of one of the shells; 2, inside ditto; 3–3, pallets; 4–4, siphons.

rabbit or mole in the earth, making a continuous gallery or hole quite smooth inside and cased or lined with shelly matter forming the sheath or cylinder above described. This shelly wall or lining or cylinder is so fragile that it is quite impossible to split the wood containing one and get it out or even a portion of any considerable size; the blow necessary to cleave the wood shatters

the shelly lining of the Teredo's gallery or burrow into countless pieces.

These burrows vary from one quarter of an inch or less to half an inch or more in diameter.

It is only in its very earliest stages that the Teredo is a free moving animal. At this time no one other than a practiced naturalist would be likely to recognize it. "It is very minute, nearly spherical, and covered with cilia or hair-like projections, by means of which it swims rapidly through the water. In thirty-six hours it assumes a new form, and speedily changes it for another, after which it returns again to its original form, so that in a very few hours the little creature is first spherical, then oval, then triangular, and then spherical again. In this stage of existence it possesses a foot which enables it to crawl after the manner of snails, and also has organs of hearing and sight."

It does not enjoy its locomotive powers for any long time but fixes itself to some suitable object, passes through its last change, becomes a veritable shipworm and begins its lifelong task of boring.

The Teredo is not very particular as to the kind of timber into which it bores, but always goes with the grain, unless it meets with some obstacle, such as a nail or a very hard knot; and in such a case it turns out of its track for a short distance and then resumes its former course. As it bores its way along, it lines the tunnel (as before stated) with a coating of shelly matter, but this is not attached or in any way connected with the body or substance of the shipworm.

It is not believed that the wood it perforates furnishes any nutriment to the animal, but that its sustenance is derived entirely from the water which is constantly passing through its body.

The holes made in the wood at the time or just after the young Teredos commence burrowing are quite small, the appearance of the surface of a pile or other infested timber is usually deceptive, affording but little evidence of the size or number of the burrows or the extent of the ravages within. After awhile the interior is so completely "honeycombed" that a slight blow or bump by a vessel upon the outside shatters the pile, &c., and their damaging work can be seen.

Upon the water front of San Francisco I have known piles, of Oregon pine and fir over a foot in diameter, rendered worthless in

eighteen months, and have heard of even a more rapid destruction of wharf piles in the harbor of that city. In one instance reported to me the destruction was accomplished in about six months. In the case which came under my notice, as above, the wood of the pile had not lost its original fresh or bright appearance when it had to be removed from the wharf and a new one put in its place. My friend, Mr. Dall, informs me of a case of the destruction of the supports of a small pier made of piles (probably pine) six to eight inches in diameter in about six *weeks*. The structure was at one of the small capes near the entrance to Chesapeake bay.

As the shipworms are gregarious, and furthermore as they grow and multiply with astonishing rapidity, their destructive work is, as shown above, often accomplished in a very short time.

The extent of their operations and the money loss entailed thereby, both upon private parties and business corporations engaged in commercial marine enterprises and on the naval equipment and appurtenances of the great maritime nations, are enormous.

This has led to a great number of experiments by governments and inventors for the protection of wood work used in marine structures.

Jeffreys remarks that "in all probability the constitution of a shipworm is poison-proof." Most of the remedies proposed in the last century were of this nature, and they signally failed.

The saturation or impregnation of the wood with creosote or some other carbolic preparation by hydrostatic pressure, the kyanizing of piles, and sheathing with copper, the filling of the exposed surface with large-headed nails have all been tried. The two last, copper sheathing and scupper nailing, Jeffreys says, "have been successfully used, but the former is expensive and the crust of iron (unless they are closely driven in so as to completely cover the piles) is superficial and liable to scale off. I have known the Teredo to bore through a pile which was supposed to be protected by large broad-headed nails in the usual way. At Christiania, in April, 1863, I found that *Teredo navalis* was very destructive to the woodwork in the harbor, and to boats lying at anchor in the fiord. The chief engineer told me that all the piles had been creosoted (ten pounds to the square foot) before they were driven in, but not to much purpose!"

Certain kinds of wood are less subject to their attacks than others. The tree palmetto of the Southern States, it is said, is never bored by the shipworm, and some of the Australian woods have similar immunity. Dr. Mueller says of the *Eucalyptus marginata* (Smith): "The Jarrah or mahogany tree of S. W. Australia, is famed for its indestructible wood, which is attacked neither by Chelura nor Teredo nor Termites, and therefore so much sought for jetties and other structures exposed to sea water, also for underground work, and largely exported for railway sleepers. Vessels built of this timber have been enabled to do without copper sheathing. It is very strong, of a close grain and slightly oily and resinous nature; it works well, takes a fine finish, and is by shipbuilders here considered superior to either oak, teak or indeed any other wood." * * * The *E. rostrata* (Schlecht), the red gum of Victoria, is another very valuable species for the "extraordinary endurance of the wood underground, and for this reason highly valued for fence-posts, piles and railway sleepers; for the latter it will last a dozen years, and if well selected much longer. It is also extensively used by shipbuilders. * * * Next to the jarrah from S. W. Australia, this is the best wood for resisting the attacks of seaworms and white ants. This species reaches a hundred feet in height."

In some of the seaports in different parts of the world there are small crustaceans that assist the shipworms in cutting away what wood the Teredo may leave. These little fellows resemble the wood-louse (pill bug), and cut either way of the grain of the wood.

In the inlets around Puget sound the destructive action of both classes of animals may be seen, especially about the time of the summer solstice, when the extraordinary fall of the tide exposes the piles (of the wharves) for their entire length. A space measured up and down on the piles for a length of four or five feet, including the portion exposed between *ordinary* tide marks, may be seen which is so completely riddled that it would seem as if the slightest loading of the deck of the wharf would result in a tumble down of the whole.

The wood-eating crustaceans referred to belong to the groups Limnoria and Chelura.

As an offset to the damage caused by these, from point of size insignificant animals, it should be borne in mind, to their credit, that by destroying old wrecks, &c., in channel ways and at the entrance to harbors, they contribute to the safety of navigation.

It is stated also that the operations of the Teredo suggested to Mr. Brunel his method of tunneling the Thames.